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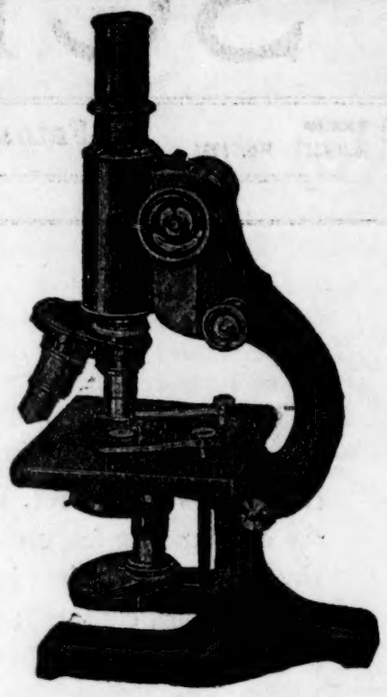

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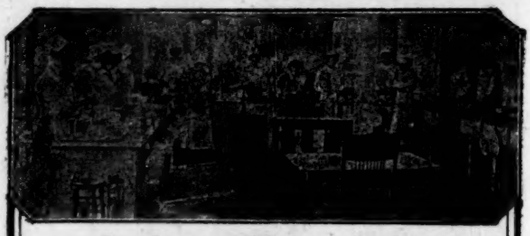

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RICHARD RATHBUN

AMERICAN science has lost one of its distinguished authorities on invertebrate zoology, and the United States National Museum its honored chief by the death of Richard Rathbun in the city of Washington early on the morning of July 16, 1918.

Richard Rathbun was born in Buffalo, N. Y., on January 25, 1852, and there studied in the public schools until he reached the age of fifteen years, when he entered the service of a firm of contractors, with which he remained for four years, acquiring a thorough knowledge of business methods, that was of special value to him during his later years.

At that time, attracted by the specimens of fossils that abound in western New York, he began the study of paleontology to which he assiduously devoted his evenings and holidays. The collection in the Museum of the Buffalo Society of Natural Sciences was made by him and he was appointed curator of that subject with charge of its collections by the society.

In 1871, he met Charles Fred. Hartt, then professor of geology at Cornell University and a pupil of the elder Agassiz, who persuaded him to give up business pursuits and devote himself to science. Young Rathbun accordingly entered Cornell and followed the regular academic course with the class of '75, specializing, however, in geology and paleontology.

The collections of Devonian and Cretaceous fossils previously obtained by Hartt in Brazil were assigned to him to work up and resulted in the publication of his first paper: "On the Devonian Brachiopoda of Ereré, Province of Pará, Brazil," in the *Bulletin of the Buffalo Society of Natural Sciences* for 1874[1] followed by a "Preliminary Report on the Cretaceous Lamellibranchs collected in the Vicinity of Pernambuco, Brazil," in the *Proceedings of*

[1] Vol. 1, pp. 236–261.

the Boston Society of Natural History for 1874.[2]

In the preparation of his paper on the Devonian fossils, he spent some time in Albany, N Y, where he came under the influence of James Hall, the state geologist of the great Empire state; and later while completing the paper on the Cretaceous fossils he studied at the Museum of Comparative Zoology, where he was so fortunate as to be able to attend a course of lectures by the elder Agassiz, then in the last year of his life.

Cambridge proved a congenial environment, and so instead of returning to Cornell, he continued at the Museum of Comparative Zoology from 1873 till 1875, acting also as assistant in zoology at the Boston Society of Natural History. During the summer months of those years he served as volunteer scientific assistant under Spencer F. Baird in the marine explorations of the U. S. Fish Commission on the New Engand coast, and thus began his connection with the Smithsonian Institution, for at that time the scientific work of the Fish Commission was practically under the direction of the Smithsonian.

In the autumn of 1875 he received the appointment of geologist to the Geological Commission of Brazil with orders to report to Professor Hartt in Rio de Janeiro, and with that service he continued until March, 1878. His first field work was in the region about the Bay of Bahia, and continued thence down the coast of the Province of the same name to near its southern end. Extensive deposits of coal said to occur in parts of that region constituted one of the special objects of the exploration, but the geology was studied in every particular, including the extensive coral reefs that lie along the coast, and also the ethnology of the Indian tribes living inland. The report on the geology and coral reefs was pubished in the Archives of the National Museum of Rio de Janeiro in 1878.[3]

Later he explored the central and southern parts of the province of São Paulo for the purpose of determining the mineral, and especially the coal, resources, and while these proved to be unimportant, he had the opportunity of studying the origin of the rich red lands where the famous coffee of that region is grown.

On returning to the United States, Mr. Rathbun brought with him complete series of the Devonian and Cretaceous fossils which have since become the property of the U. S. National Museum. It had been his hope to have monographed this interesting material, but other duties claimed his attention and with the exception of a few papers such as "A List of the Brazilian Echinoderms, with Notes on their Distribution," which he contributed to the *Transactions of the Connecticut Academy of Arts and Sciences* for 1879,[4] the material was worked up by other scientists.

Meanwhile he had accepted from Secretary Baird the appointment of scientific assistant in the U. S. Fish Commission with which Service he then continued until 1896. At first the collections of the Fish Commission were preserved in the museum of Yale University in the custody of Professor A. E. Verrill, to whom he was detailed as assistant, serving also at that time as assistant in zoology at Yale University.

In 1880, owing to the approaching completion of the U. S. National Museum building, Mr. Rathbun was transferred from New Haven to Washington and brought with him a part of the collections which had been stored at the former place. At that time he was made curator of the department of marine invertebrates in the National Museum, an appointment which he continued to hold until 1914.

As the Fish Commission grew, much of the administrative work was assigned to Mr. Rathbun by Secretary Baird and the responsibility steadily increased until Baird's death in 1887. Meanwhile, although Professor Verrill of Yale was the nominal head of the summer investigations of the Fish Commission, during much of the time Mr. Rathbun had active charge of the laboratories, steamers, and equipment and was responsible for the general management

[2] Vol. 17, pp. 241–256.

[3] Vol. 3, pp. 159–183.

[4] Vol. 5, pp. 139–158.

of the work. The collections were mostly assorted under his supervision for distribution to specialists. His own studies at that time related to the commercial fisheries and to the working up of the natural history of several groups of invertebrates.

During 1880 and 1881 he was employed upon the fishery investigations of the Tenth Census and reported on the natural history of, and the fisheries for, the commercial lobsters, crabs, shrimps, corals and sponges; the marine fishing grounds of North America with the ocean temperatures of the Atlantic coast of the United States. Much of this material appeared in "The Fisheries and Fishery Industries of the United States," which was prepared through the cooperation of the Commissioner of Fisheries and the Superintendent of the Tenth Census under the direction of George Brown Goode. Mr. Rathbun's contributions to these official reports amounted to 550 quarto pages with 106 plates.

Incidental to his work at this period was his association with colleagues in the gathering of material for the Great International Fisheries Exhibition held in London in 1884. He prepared and described the "Collection of Economic Crustaceans, Worms, Echinoderms and Sponges"[5] and he was the author of the "Descriptive Catalogue of the Collection illustrating the Scientific Investigation of the Sea and Fresh Waters."[6]

In 1891, at the request of the Secretary of State, he assisted John W. Foster in preparing material for the United States case at the Paris fur seal tribunal. He had the services of several experts, and was called to report upon the laws of all nations relating to the extra-limital fisheries for whales, hair seals, fisheries, precious corals, pearls, beche de mer, etc., and also upon the distribution and habits of these forms. Reports of progress were made daily to Secretary Foster, and the more essential parts of the completed report were incorporated in the extended brief of the American agent.

During the entire period of the fur seal inquiries Mr. Rathbun was in charge of the investigations, except those of the first international commission. The steamer *Albatross* made yearly trips to Bering Sea with one or more experts, who were directed to study the habits of these animals, and to make an annual comparative record of their distribution and numbers by written notes and identical series of photographs. The work was also extended to the Russian islands.

The most important international commission to the Fur Seal Islands was the one despatched in 1896. This expedition, with the cooperation of the Secretary of State, was conducted by the Treasury Department. Charles S. Hamlin, then Assistant Secretary of the Treasury, was in immediate charge of the case, and Mr. Rathbun was called to be his chief adviser. The latter was asked to become the head of the American Commission, but, declining, was requested to nominate its members, which he did. Mr. Rathbun also prepared the instructions for the commission, which entered into every detail and every accusation on the part of Canada.

In December, 1892, Mr. Rathbun was appointed by President Harrison as the American representative on the Joint Commission with Great Britain to study the condition of the fisheries in the boundary waters between the United States and Canada and the sea coast waters adjacent to the two countries, and to report such measures as might be deemed necessary to insure the protection of these fisheries. No similar investigation of such magnitude and importance was ever before attempted and four years were required for its accomplishment. A large party of experts was put in the field on the part of the United States, and Canada assisted to the extent of its facilities. Mr. Rathbun personally visited every point of interest, starting with the Gulf of St. Lawrence, continuing through the fresh water systems, including the Great Lakes, and ending at Cape Flattery at the west. The report, submitted to the Department of State on December 31, 1896, was transmitted by the President to Congress and printed.

It had been Secretary Baird's intention to

[5] Bull. 27, U. S. Nat. Mus., pp. 107–137.

[6] *Idem*, pp. 511–622.

have Mr. Rathbun transferred to the National Museum so that he might give his entire time to the development of the department of marine invertebrates and the working up of the important collections that were constantly being received, but on the death of Baird in 1887, Dr. G. Brown Goode, who succeeded temporarily to the office of Fish Commissioner, persuaded Mr. Rathbun, in consequence of his long experience and familiarity with the work, to remain with the commission. Later, when Colonel Marshall McDonald became permanent commissioner, he was equally appreciative of Mr. Rathbun's valuable qualities and likewise was able to induce him to remain with the bureau until his own death in 1895.

In 1896, on the invitation of Secretary Langley, he accepted appointment in the Smithsonian Institution, and on January 1, 1897, began his duties as Assistant in charge of Office and Exchanges. Before the expiration of the month his abilities were so manifest and his appreciation of the conditions so complete that he was made Assistant Secretary. This place he then held until July 1, 1898, when, still continuing as Assistant Secretary, he was given charge of the National Museum, in which capacity he remained until his death.

It is almost impossible to attempt to consider in detail the many ramifications of the great work that he accomplished, and naturally the minor, but certainly not unimportant, interests are obscured by the larger events to which he gave the later years of his life.

The most important of these was the construction of the new building, in which the natural history collections are preserved. His intense interest in this undertaking, as well as his remarkable capacity for studying details, is perhaps best shown by his careful preliminary study "The United States National Museum. An Account of the Buildings occupied by the National Collections," that appeared in the annual report of the U. S. National Museum for 1903.[7]

The years of patient watching and waiting for the completion of the structure, with his perfect knowledge of every detail, can never be satisfactorily told in words, but they are strikingly illustrated by the careful "Descriptive Account of the Natural History Buildings of the U. S. National Museum" that forms No. 80 of the Bulletin series,[8] that he published in 1913 on the completion of the building.

These two publications show how much he gave of himself to the perfection of a work that must always remain as the greatest monument that can be reared to his painstaking genius.

With an interest equal to that shown by him in the construction of the new museum building, he undertook the development of the National Gallery of Art, an important feature of the Smithsonian Institution, which although the one mentioned first in the fundamental act, had remained dormant for lack of adequate facilities. The valuable collection of paintings and art objects bequeathed by Mrs. Harriet Lane Johnston in 1903 to the National Gallery of Art afforded an opportunity quickly appreciated by Mr. Rathbun, who, recognizing its importance, began at once to plan for the building up of a great national art gallery. In 1904, the Freer collection with its unique specimens of Whistler's art work, was tendered and accepted by the Institution, and in 1907, William T. Evans began his gifts of selected paintings by contemporary American artists, which number more than 150 canvases and an equal number of other art objects. With these and other gifts the National Gallery of Art has "attained a prominence that has brought world-wide recognition." A permanent record of this development has been left by Mr. Rathbun in Bulletin No. 70 of the U. S. National Museum, under the title of "The National Gallery of Art, Department of Fine Arts of the National Museum,"[9] a volume remarkable for its artistic appearance, to every detail of which he gave his personal attention.

His natural taste for research and his tendency to go to the bottom of things led him to make elaborate studies on the collections, and

[7] Pp. 177–315, pls. 1–29.

[8] Pp. 1–131, with plates 1–34.

[9] First ed., 1909, pp. 1–140, pls. 1–26; 2d ed., 1916, pp. 1–189.

he has left behind him a valuable series of notes from which the future historians will find little that is lacking concerning the early history of the museum. At times interesting developments presented themselves, and as typical of those his last important publication may be cited. It was "The Columbian Institute for the Promotion of Arts and Sciences. A Washington Society of 1816–1838, which established a Museum and Botanic Garden under Government Patronage" (pp. 1–85), which was published as No. 101 of the Bulletin series of the National Museum in 1917.

Subsequent to the death of Secretary Langley, in February, 1906, and until the election of his successor a year later, Mr. Rathbun served as acting secretary, and frequently during the absence of Secretary Walcott the guidance of the affairs of the parent institution was entrusted to Mr. Rathbun as acting secretary.

His bibliography numbers nearly one hundred titles, and, in addition to those already mentioned, he was the author of various scientific papers contributed to the serial publications of the Fish Commission and the National Museum, as well as a few biographies of friends and colleagues, such as Charles F. Hartt and Jerome H. Kidder; several popular articles contributed to current literature; and a series of official reports of which, notably those of the National Museum, are conspicuous evidences of his patient industry.

Intense devotion to duty was a striking trait of Mr. Rathbun's character, and so, absorbed in the details of his various activities, all of which had to do with the institution to which he gave his life, he had but little time for other interests.

Nevertheless, his scientific work gained deserved recognition from Indiana University, which in 1883 conferred upon him the degree of M.S., and in 1894 Bowdoin gave him her doctorate in science.

His colleagues found pleasure in dedicating in his honor recently discovered forms of life, and a genus of fishes, *Rathbunella* ("in recognition of his many services to science"), as well as a genus of starfish, *Rathbunaster* ("in appreciation of his pioneer work on Pacific starfishes") and many new species of plants, batrachians, fishes and mollusks preserve his name in the literature of science.

Naturally he was a member of many scientific societies. At home he was active in the Biological Society of Washington, and he was an early member of the Philosophical Society, becoming its president in 1902; also he was a member of the Washington Academy of Sciences, and in 1905 he was chosen by his associates to be president of the Cosmos Club, an honor that he greatly appreciated.

Among the national societies he was a fellow (since 1892) of the American Association for the Advancement of Science, corresponding member of the Boston Society of Natural History, member of the American Society of Naturalists, councilor of the American Association of Museums, and a member of the American Fisheries Society.

His foreign connections included membership in the Fisheries Society of Finland, the Russian Imperial Society for the Acclimatization of Animals and Plants, and corresponding membership since 1917 in the Zoological Society of London.

Mr. Rathbun was also a permanent councilor of the International Fisheries Congress, a member of the American Committee for the Boston meeting of the International Zoological Congress, and in recent years every gathering of scientists, such as the International Congress of Applied Chemistry, the International Congress of Americanists, and the Second Pan American Scientific Congress held in Washington, placed his name on their honor lists of distinguished members.

At a memorial meeting of the various members of the staff of the Smithsonian Institution and its branches, held in the National Museum on the day of Mr. Rathbun's death and presided over by Mr. Henry White, a regent of the institution, record was made of "their profound sorrow at the loss of a sincere friend, an executive officer of marked ability, and one whose administration has had a wide influence upon the scientific institutions of the nation."

MARCUS BENJAMIN

THE OLONA, HAWAII'S UNEXCELLED FIBER-PLANT

The Hawaiian people formerly made use of a considerable range of fiber plants. Some of these were brought by the natives from the South Pacific, others were discovered in the new island home. The paper mulberry, *Broussonettia papyrifera*, is an excellent example of a fiber-plant widespread in the Pacific region. From its copious bast was made the typical *kapa* or bark-cloth of Polynesia. The *olona* (*o-lo-na*) *Touchardia latifolia* Gaud., on the other hand, is wholly confined to the Hawaiian Islands; the genus is monotypic and endemic. The ancient Hawaiians undoubtedly discovered the valuable fiber of this plant at a very early time. They were intimately familiar with the local flora and its economic utilization. The *olona* is mentioned in many of the old songs and legends.

Special interest is attached to the *olona* fiber as it is generally recognized *to be the strongest and most durable fiber in the world.* No other fiber is recorded to exceed it in these two important characteristics. So far as is known to the writer, the present paper is the first and only extant concise and comprehensive account of the *olona.*

The urticaceous genus *Touchardia* was named and described by Charles Gaudichaud-Beaupre, generally known as Gaudichaud. He was botanist for the great French expedition under Freycinet, 1817–1820, and for "La Bonite" during its circumnavigation of the globe, 1836–37. The botany of the latter voyage, in which *Touchardia* is described, was published under the title "*Botanique du Voyage autour du Monde . . . sur la Bonite.*" The salient features of the genus are as follows: Flowers diœcious, on globose receptacles. Male perigone 5-parted, the segments imbricate in the depressed bud. Stamens 5. Female perigone subcampanulate, 4-lobed or toothed. Ovary straight, almost as long as the perigone. Ovule oblique, ascending. Stigma spathulate, with one face and the margins papillose-ciliate. Achene smooth, compressed, oval, invested by the rather fleshy adherent perigone. Albumen very scanty. Cotyledons ovate, subcordate, conduplicate, and twice as long as the thick radicle.

The single species *latifolia* was named with reference to the large, broad leaves, which form a conspicuous feature of the plant. It is an erect woody shrub, 4–10 ft. high, and sparingly dividing into stout branches. It is from the thick bark of these wand-like erect shoots that the highly prized fiber is obtained. The youngest shoots are hispid, but soon glabrate; the colorless latex is viscid and not plentiful.

The leaves are alternate, large, and with petioles of 3–10 inches. The upper leaves have short petioles, the lower leaves have greatly elongated petioles. The leaf-blade is 9–16 inches long by 5–10 inches broad, ovate, with acute or acuminate apex and rounded base. The margin is obtusely crenate. The blade is chartaceous, dark-green on both faces, and glabrous, excepting a few small hairs along the veins. Unlike many urticaceous plants, the leaves are not armed with stinging hairs. The veins are conspicuously tripli-venate at the base of the leaf, the lateral veins not reaching the middle of the margin; toward the apex it is pinnate, with rectangular areoles. The stipules are large, 2 inches long, axillary, entire and acute. They form one of the easily recognized characters of the plant. The midribs, petioles, stipules, etc., are often dark red.

The flowers are pedicellate and bracteolate. The globose glomerules are generally arranged in repeatedly forking cymes, with one branch suppressed and the middle glomerule sessile. The male cymes are longer (3–5 in.) and broader (5–6 in.) than the female cymes, which are also more crowded. The male glomerules are 6–8 lines in diameter, with a perigone of 1½–2 lines, the lanceolate segments hooded and obtuse or tuberculate below the apex. The stamens are shortly exerted; anthers large, white. The rudiment of the pistil is glabrous. The female glomerules are 4–5 lines in diameter; perigone 1 line diameter, orange-colored upon maturity; style as long as the achene. Like many of the plants of the rain-forest the *olona* is quite variable as to its flowering period; flowering plants may be obtained at any season of the year.

The natural habitat of the *olona* is the lower and middle forest zone, lying on the mountains between elevations of 800–1,800 feet. It is strongly hygrophytic and shade-loving; it never occurs naturally in the open or in dry sections. The favorite habitats are deep, cool, gloomy ravines, or moist slopes that are well screened by forest cover. The *olona* belongs to that ecologic section of the Hawaiian flora that luxuriates in the dense moist shade of the montane forests. The zonal limitations of *olona* are clean-cut; it does not occur on the lowlands, nor at the higher levels. It inhabits all of the larger islands of the archipelago. Representative regions are the rain-forests of Wai-ale-ale, Kauai, Waianae and Koolau Ranges, Oahu; East Molokai; West Maui and Hale-a-ka-la; and the extensive forests on the island of Hawaii. It occurs in little patches or thickets here and there in the forest, but is nowhere abundant. It does not form continuous stands; reproduction is not vegetative but apparently always from seed. In any one spot the collector is not likely to find more than a few score individual plants.

The Hawaiians formerly cultivated the *olona* in a primitive manner. They did not prepare the land or plant seed, but merely searched out good patches of the wild plants. Such a patch was cleared of any obstructing vegetation, not disturbing, however, the large trees which shaded the plants. If the *olona* plants were too crowded they were thinned out. The old plants were pruned so as to give a number of young, straight shoots.

At irregular intervals, as convenience or necessity dictated, the grove was visited and the crop harvested. This process consisted in cutting all the long, straight shoots that had reached a diameter of about one inch. The bark of such shoots was rich in bast fibers, and these were of maximum length. Six feet was an average length. The bark was carefully stripped from the wands, in one or more pieces, packed into rolls or bundles, and carried down to the settlements on the lowlands, where the final operations were performed.

A suitable situation was found along a stream or irrigation ditch. The bundles of bark were opened and spread out in the shallow running water, where they were allowed to partially macerate. This required several days; then the long strips were removed from the water and the remaining pulpy matter was scraped from them while still wet. The scraping was performed on a long, narrow, hardwood board, specially devised for this purpose and known as "*la-au kahi olona.*" The scraper was made of pearl shell (*Margaritifera fimbriate*) or turtle-shell plate (*Chelone mydas*), and was called "*uhi kahi olona kau honu.*" The prepared fiber was carefully dried and rolled into cordage of various sizes.

In ancient Hawaii the *olona* was venerated as a sort of deity or lesser god. Before spinning the fibers the natives made libations, and offered sacrifices of hogs, fowls, etc. The following excerpt of an old chant—the *mele* of Kawelo—vividly describes the preparation of the *olona* fish-net:

I, as chief, willingly
Cast my net of *olona;*
The *olona* springs up, it grows,
It branches and is cut down.
(The paddles of the chief beat the sea.)
Stripped off is the bark of the *olona,*
Peeled is the bark of the yellow *moki.*
The fire exhales a sweet odor;
The sacrifice is ready.
The bark is peeled, the board is made ready,
The *olona* is carded
And laid on the board.
White is the cord.
The cord is twisted on the thigh,
Finished is the net!
Cast it into the sea,
Into the Sea of Papa; let him fall,
Let him fall, that I may strangle the neck
Of Uhumakaikii.

Uhumakaikii was a legendary sea-monster, who could raise great waves and capsize canoes.

Formerly every chief had in the mountains one or more plantations of *olona,* which were tended by his dependents and which supplied him with sufficient quantities of this valuable product. Taxes were not infrequently paid with *olona,* as the fiber was nowhere so abundant as to depreciate its exchange value.

Among the Hawaiians it was put to a great

variety of uses. All fishing lines and nets of the best quality were invariably made of *olona*, because of its high resistance to the action of salt water. *Olona* lines and nets which have been in more or less constant use for over a century are almost as good as new, and are handed down from generation to generation as precious objects. Most of the natives are very unwilling to part with any of their fishing gear that is made of olona. The very serviceable carrying-nets, *koko*, in which the wooden calabashes and other objects were borne, were commonly made of *olona* fiber. *Olona* was not used for making the bark-cloth or *kapa* itself. but threads and cords of *olona* were used for sewing the *kapa*. A stout cord of *olona* was usually attached to the wooden war-clubs and dagger-like swords, for suspending the weapon from the wrist. This prevented the loss of the weapon during the fray. For fastening the stone adz, *oo*, to its wooden handle, *olona* was always the preferred fiber.

It was used for the very fine and pliable netting which served as a groundwork for the feathers, in the construction of the splendid garments and insignia of the ancient royalty and *alii*. The brilliant scarlet and yellow feathers were skillfully woven by the women upon the imperishable framework of *olona*.

Mr. William Weinrich, manager of the Hawaiian Sisal Company's extensive plantation, has made an exhaustive study of fibers in the Hawaiian Islands, and has kindly prepared for the writer the following statement concerning *olona*:

> This fiber not only partakes of all the best characteristics of this genus, but is superior to any of its members, producing the best of all fibers known at the present time. The three dominant features are
>
> First—the great tensile strength. I estimate that the strength of *olona* is about three times the strength of commercial Manila. The statement is made that *olona* is about eight times as strong as the hemp, *Cannabis sativa*. So far as I can gather, this great strength is due to the unusual length of the cell in proportion to its width.
>
> Second—its great resistance to deterioration in salt water. I once examined a ball of *olona* fishline, the Hawaiian owner of which stated that it had been in their family, and in constant use, for over fifty years. At the time I saw it, the fiber was in an excellent state of preservation.
>
> Third—its pliability, and thus its adaptability for spinning by hand. Fishing lines and nets made from this fiber by expert Hawaiians present an appearance of so uniform a caliber and twist that it would lead one to believe that the fiber had been made by the most intricate machinery.
>
> It was the writer's pleasure, some years ago, to send samples of the *olona* fiber to the manufacturers in the East. To my surprise, the fiber was found to be absolutely unknown in that market.
>
> A fiber with these characteristics should be exploited to the fullest measure. The extraction of this fiber is not a difficult process. In the history of Hawaii we find references to this fiber as having been grown on a large scale as a source of revenue; but, like many other things Hawaiian, its usefulness has been lost sight of during the progress of civilization.
>
> The key to the situation lies in transforming this plant from its wild state to a cultural form. When this is done, the world will be in possession of a new fiber, having a greater tensile strength, weight for weight, than any other fiber known.

Vaughan MacCaughey

College of Hawaii,
Honolulu

THE BARBADOS-ANTIGUA EXPEDITION FROM THE STATE UNIVERSITY OF IOWA

The Barbados-Antigua Expedition from the State University of Iowa returned to New York on August 1, with all its members in good health and without mishap of any kind.

There were nineteen persons in the party, nearly all of them instructors or graduate students from the State University of Iowa. Their object was not only to secure collections in marine zoology, entomology and geology from a region in which little work had hitherto been done; but also to study the living forms in and around the islands visited and thus supplement the future more intensive work based on the collections secured.

In both Barbados and Antigua the colonial authorities provided excellent quarters for the party and adequate laboratory facilities in government buildings, and both officials and

private citizens aided the enterprise in every possible way.

At Barbados dredging was accomplished at about one hundred stations, working down to over 150 fathoms. This was rendered possible by the use of a fully equipped 27-foot launch provided by Mr. John B. Henderson, of Washington, who accompanied the expedition and who will report on the collections of Mollusca of which many new or rare forms were taken.

Practically all species taken with the dredge or tangles will provide new locality records extending the known geographical range. The fauna, while not so rich as that of the western end of the Antillean chain, or the continental shelf off the Florida Keys, is of remarkable interest from a distributional standpoint, while a number of new forms will interest the systematist. The apparent scarcity of certain groups abundant in the western parts of the West Indies, such as the Asteroidea, was something of a surprise. As is usually the case in a region of growing corals the cœlenterate fauna was most conspicuous, but there seemed to be a remarkable scarcity of medusæ. Indeed the pelagic fauna was rather poor.

Shallow water forms, on the contrary, were remarkably abundant and interesting, furnishing ample material for laboratory work and study of forms *in situ*. Some probably new forms of actinians and corals were secured. *Balanoglossus* was found in the sand near our laboratory on Pelecan Island.

By employing a native diver many species were secured at depths from three to nine fathoms. Some remarkably fine corals and alcyonarians were thus obtained. The use of fish-pots and native fishermen resulted in a fairly complete set of reef fishes which would not otherwise have been secured. Very few deep-water fishes were taken.

Many gorgeously colored comatulics were dredged, but the pentacrinoids were represented by but a single *Rhizocrinus*. The serpent stars were, as usual, very abundant and a number of simple-armed basket-fish were found. Crustacea were, of course, particularly numerous, perhaps the most interesting being small macrourans secured by breaking up old coral heads.

At Antigua the party was given quarters at the old dock-yard at English Harbor, a formidable naval base in Nelson's time. Here the conditions were entirely different from those at Barbados. The trade-winds were so strong and constant during our stay that little dredging could be accomplished, and the entire time was devoted to shallow-water forms in English Harbor, Falmouth Harbor and Willoughby Bay. These waters were over mud bottoms; the shores, however, being varied in the form of mud flats, mangrove swamps, sand beaches and rocky shores. Here were found a veritable wealth and variety of aquatic forms, a great majority being different from those secured at Barbados.

Tube-dwelling worms, some of great size and beauty, were perhaps the most striking feature; tunicates and holothurians coming next in point of abundance both in individuals and species. Among the Mollusca, a great quantity of beautiful *Murices* were collected off the sea wall, where they seemed to be devouring the soft parts of a bivalve (*Perna*) that was attached in great quantities near high-water mark. A very large Chætopod, called locally "sea scorpion," was found to bore through a heavy *Livona* shell, making a hole as smooth as a drill.

Large and wonderfully beautiful anemones of several species were abundant, particularly in Falmouth Harbor, as well as the finest colonies of *Pennaria* that I have ever seen. The Echinoidea were well represented, mostly by well-known forms.

One small spatongoid was found to live buried from six to twelve inches under the sand. Among the Crustacea, a very large land-crab, with orange brown carapace and purple and white chelæ, was perhaps the most striking form.

At both Barbados and Antigua extensive collections were made in the field of geology by Professor A. O. Thomas. Mr. Henderson made a practically complete collection of land mollusks, while Mr. and Mrs. Dayton Stoner did faithful and successful work in the entomological field, in which they were very materially aided by both the local and imperial departments of agriculture. The field of

botany had no professional representative in the expedition; but considerable collecting and field work done by Mr. Willis Nutting. A fine series of two species of bats were secured at Antigua.

As already indicated, Mr. John B. Henderson will report on the Mollusca. The reef fishes will be reported on by Dr. Barton W. Evermann, Professor W. K. Fisher will attend to the Asteroidea and Holothuroidea, while the writer will probably report on the Hydroida and Aleyonaria. The other groups have not as yet been assigned.

A large series of excellent photographs, including moving picture films, was secured by Mr. Maurice Ricker, official photographer of the expedition.

C. C. Nutting

State University of Iowa,
August 30, 1918

SCIENTIFIC EVENTS

THE JOURNAL OF THE AMERICAN CERAMIC SOCIETY

A journal that is a pioneer in its field is always the subject of most careful scrutiny. When that field is representative of one of the oldest phases of human endeavor the cause for attention to the new publication is multiplied many fold. There has now appeared the first issue of the *Journal of the American Ceramic Society*, a monthly journal devoted to science and technique of the ceramic industries.

The American Ceramic Society belongs to the older family of scientific societies in the United States. The first meeting of the society, which was in reality a little family gathering of a small group of ceramic enthusiasts, was held in Columbus, Ohio, in February, 1899, and from that meeting grew the present organization due largely to the guiding genius of Professor Edward Orton, Jr., of Ohio State University. The society is, therefore, in its twentieth year of vigorous and active life. The membership has increased from that early day until at present there are over 1,000 enrolled in the society.

In the American Ceramic Society, the term ceramic is synonymous with "silicate industries" and the interests and activities of the society include all branches of the clayware, glass and cement industries as well as enameled wares of all kinds and in addition other closely allied products are included, chief among which are abrasives, gypsum and lime. Few people realize the gigantic proportions of these ceramic industries. The products of the three major divisions alone (clayware, glass and cement) aggregate over $400,000,000 per annum.

In the earlier days the society consisted of one main organization only. With increased activities and with enlargement in its scope of usefulness it became necessary to organize local sections and student branches as shown in the following list.

LOCAL SECTIONS

St. Louis Section
Chicago Section
Central Ohio Section
Northern Ohio Section
West Virginia Section
Beaver Section
New England Section
New York State Section
New Jersey Section
Pacific Coast Section

STUDENT BRANCHES

Ohio State University Student Branch
New York Student Branch
University of Illinois Student Branch
Iowa State College Student Branch

The publication work of the society has, up to the present time, been confined to the issuing of our annual volume of *Transactions*. Twenty years ago this was a small feeble effort, very creditable for the then-existing state of our knowledge of the science of the silicate industries. This annual volume has shown continuous growth and the 1917 volume comprises 707 pages of well-edited contributions. The American Ceramic Society's *Transactions* have, for many years, been known throughout the world as the standard reference books on the silicate industries.

This remarkable growth in strength and influence of the society has made it essential that periodical publication of the researches and other activities of the society members be

undertaken and the monthly *Journal of the American Ceramic Society* is the logical result.

The first number is a very attractively prepared journal of seventy-two pages. It is well edited and well printed on good paper. The contents of the first number are as follows:

Editorials:
- To the Public
- The Fuel Curtailment Orders
- The National Research Council
- Edward Orton, Jr.

Original Papers and Discussions:
- Kaolin in Quebec—Keele
- Special Pots for the Melting of Optical Glass—Bleininger.
- The Effect of Gravitation upon the Drying of Ceramic Ware—Washburn
- Test of a Producer Gas-Fired Periodic Kiln—Harrop
- Notes on the Hydration of Anhydrite and Dead-Burned Gypsum—Gill

Meetings of the Local Sections, American Ceramic Society

The present officers of the society are:

President—Homer F. Staley,
Vice-president—A. F. Greaves-Walker,
Treasurer—R. K. Hursh,
Secretary—Charles F. Binns,
Trustees—
- A. F. Hottinger,
- E. T. Montgomery,
- R. D. Landrum.

Membership in the society is open to any one interested in any branch of the ceramic industries and application should be made to the society. All members receive the *Journal* gratis.

C. F. B.

ENGLISH VITAL STATISTICS

THE *Journal* of the American Medical Association reports that the English registrar-general's seventy-ninth annual report on vital statistics for the year 1916, which has just been published, is of unusual interest, because in that year the war existed long enough to affect the figures considerably. The birth rate was 20.9 per thousand living, and was the lowest on record. It was 4.6 below the average for the ten years 1905–1914 (which were practically unaffected by the war). On the whole, the reduction of natality, which amounted to about 12 per cent. on the figures for 1914, is less than might have been expected, and compares favorably with the experience of other belligerent countries. The civilian death rate was 14.1 per thousand living, and was slightly below the average of the decennium before the war. The rate of 1916 is considered to be the lowest recorded, provided allowance is made for the effect of enlistment on the population. The standardized mortality of males ordinarily exceeds that of females. Up to 1860 the excess was not more than 9 per cent.; but in 1916, in consequence of the war, the excess amounted to 32 per cent. The most remarkable feature is the low death rate in the first quinquennium of life. It was much lower than any previously recorded, and was less than half the rate prevailing in the concluding years of the last century. The all-age mortality from typhoid and from scarlet fever was the lowest on record, while diphtheria and influenza were more fatal than the average. But the death rate from tuberculosis showed a further advance on the high rate of 1915, although the increase did not extend to young children, the mortality under 5 years being the lowest hitherto recorded. Cancer was more fatal in 1916 than in any other year, and cerebrospinal fever continued to be abnormally destructive. In view of the loss of life in the war statistics of childhood are of unusual importance. The births in England and Wales in 1916 were in the proportion of 1,049 males to 1,000 females, against 1,033 to 1,000 in the preceding five years. This proportion is by far the highest recorded during the last half century. It certainly bears out the old view, regarded by some as a superstition, that war increases the proportion of male births because nature endeavors to compensate for the loss of male life in warfare. Of the deaths at all ages, 41.1 per cent. were those of infants under the age of 1 year. These deaths correspond to a mortality rate of 91 per thousand births, the lowest ever recorded. It was below the average in the preceding decennium by 20 per cent. This decline was in part due to low diarrheal fatality, but the greater part of it is accounted for under other diseases less subject to climatic

influences. The mortality in infants from tuberculosis was 2.39 per thousand births, much the lowest on record.

WAR COMMITTEE OF TECHNICAL SOCIETIES

THERE has been organized a war committee of technical societies consisting of the following members: American Society of Civil Engineers, Nelson P. Lewis, Major James M. Boyle; American Institute of Electrical Engineers, Harold W. Buck, Dr. A. S. McAllister; American Society of Mechanical Engineers, Professor A. M. Greene, Jr., R. N. Inglis; American Institute of Mining Engineers, David W. Brunton, Edmund B. Kirby; American Gas Institute, Dana D. Barnum, E. C. Uhlig; American Electrochemical Society, Joseph Bijur, Dr. Chas. A. Doremus; Illuminating Engineering Society, Louis B. Marks, Preston S. Millar; Mining and Metallurgical Society of America, Christopher R. Corning, George C. Stone; American Society of Refrigerating Engineers, Henry Torrance, F. E. Matthews; American Institute of Chemical Engineers, Dr. Chas. F. McKenna, Frank E. Dodge.

The chairman, D. W. Brunton, has addressed the following letter:

The men who, at the call of patriotism and duty, have joined the colors, are not only risking their lives, but are cheerfully sacrificing their careers and in many instances their financial interests to protect the honor of the nation. It, therefore, becomes the duty of those of us who, for various reasons, are unable to enlist, to do something more than our share in keeping the machinery of industry moving.

Other wars have been fought only on land and sea, but in this conflict the combatant areas have been greatly extended by the advent of submarines, flying machines and even subterranean warfare. In previous wars the armies and navies of belligerents were practically the only forces engaged; in this war the full economic strength of nations is drawn into the contest and every branch of scientific and industrial effort is taxed to the utmost.

Intensifying production and conserving the supply of food and clothing constitute service within the reach of all, but the engineers, electricians and chemists of this country can go a step further and utilize their technical training to develop such new devices and improvements, equipment and methods as will give our Army and Navy that superiority which will assure victory.

Inventive talent in this country is by no means confined to the membership of our societies; members who have employees or acquaintances of an originative turn of mind should make an effort to stimulate that most useful talent by passing on to such persons the bulletins as they are received, and also by calling attention to the numerous ably written articles on the mechanical phases of the war, published in technical and popular magazines.

In the world-conflict which is going on to-day the three dominating factors, the submarine, the automatic machine gun and the flying machine, are all American inventions. This nation is still in its youth and can therefore be expected to do in future still greater things than it has done in the past. War is a new occupation to us, but under the stimulus and pressure of its necessity, we should advance as far in the arts of war during the next two years as we normally would in twenty.

Some of the civilian engineers of this country are now rendering great service to the government through the agencies of the Council of National Defense, the Naval Consulting Board, the National Research Council and their numerous auxiliary committees, but unfortunately only a small proportion of the technical men of this country are so situated that they can go to Washington and engage in this service; therefore, some means of utilizing the patriotism and originative thought of our members had to be devised.

For this purpose the War Committee of Technical Societies has been organized, and it hopes to give the members of the technical societies who are obliged to stay at home, an opportunity to use their inventive talent and technical training in the study of the varied problems which arise in the preparation for and prosecution of the war—thus making valuable contributions to the national cause.

The greatest care will be taken to discover and utilize everything of value that may inhere in suggestions and inventions submitted. Not only will they receive studious examination, but when necessary, trials and experiments will be conducted. All inventions which have successfully passed the necessary examinations and tests are turned over to the particular department of the Army and Navy Service where they may be most profitably utilized.

D. W. BRUNTON,
Chairman

THE NEED FOR NUTRITION OFFICERS IN MILITARY CAMPS

THE Surgeon-General has been authorized to station in each of the larger military camps and cantonments in this country a nutrition officer whose duties will be those of an adviser to the camp commander, the camp surgeon and the camp quartermaster on all matters relating to the nutritive value of foods. There is still need for a considerable number of men well trained in food chemistry and physiology of nutrition, who can qualify as lieutenants and captains in the Sanitary Corps for this assignment. Upon receiving commissions these officers will be given training for a period at the Medical Officers' Training Camp, Camp Greenleaf, Fort Oglethorpe, Georgia, and will then be subject to appointment as nutrition officers, or to duty of a similar nature overseas. This work has proved to be of signal importance in the interest of proper nutrition of the soldiers and of the economic use of foods both in this country and overseas. Application for information should be made to Lieutenant Colonel John R. Murlin, Sanitary Corps, Office of the Surgeon General, 7th and B Sts., NW., Washington, D. C.

The following officers of the Division of Food and Nutrition of the Medical Department, U. S. Army, are on duty overseas:

Majors Phillip A. Shaffer, A. J. Carlson, Ernest B. Forbes, John P. Street.

Captains Frank C. Gephart, Walter H. Eddy, Fred F. Flanders, J. Garfield Riley, Ernest L. Scott, Leon A. Congdon, H. A. Mattill, F. B. Kingsbury, Marion G. Mastin, Arthur W. S. Thomas, Drury L. Weatherhead.

Lieutenants Cleon C. Mason, Willard R. Line, C. A. Cajori, A. G. Hogan, S. C. Dinsmore, A. A. Reithwiesner, A. F. Wussow, F. J. Funk, L. V. Burton and A. A. Schaal, Sanitary Corps.

Lieutenants A. D. Shohl, Rolla B. Hill, R. W. Bury and A. T. Hipps, Medical Reserve Corps.

SCIENTIFIC NOTES AND NEWS

DR. EDWARD A. SPITZKA has been promoted to be lieutenant colonel in the Medical Corps, U. S. A.

MR. WILLIAM BOWIE, hydrographic and geodetic engineer and chief of the division of geodesy of the U. S. Coast and Geodetic Survey, has been commissionel a major in the Corps of Engineers, U. S. Army and has been assigned to duty in the department of map making.

PROFESSOR ROSS P. ANDERSON, of Cornell University, has received a captaincy in the Chemical Warfare Service of the United States Army and has been sent to France. For the last year, Captain Anderson has been absent from Cornell on leave, carrying investigations on the removal of gasoline from natural gas for the United Natural Gas Company, of Oil City, Pa. While at Cornell he had charge of the courses in gas analysis.

CAPTAIN J. F. MCCLENDON, Sanitary Corps, U. S. A., has been ordered to Camp Fremont, Menlo Park, California, to serve as nutrition officer of that camp. He has leave of absence for the period of the war from his position as associate professor of physiology, University of Minnesota Medical School, Minneapolis.

A. H. HOLT, of the college of applied science, University of Iowa, has been appointed captain in the Engineering Corps of the Army and is stationed at Camp Lee, Va.

DR. FLOYD K. RICHTMYER, assistant professor of physics at Cornell University, has left Ithaca to accept a temporary civilian appointment as radio engineer in the Signal Corps of the United States Army at Washington. The appointment was made as a result of research work done by Professor Richtmyer this summer. He plans to return to Ithaca before the university reopens in October.

THE experimental ammonia plant and laboratory of the Bureau of Soils at Arlington, Virginia, has been transferred to the Nitrate Division of the Ordnance Department of the Army. The work is in charge of Dr. R. O. E. Davis and Mr. L. H. Greathouse.

DR. WILLIAM T. MCCARTY has been appointed physical director of the aviation unit at Mineola, N. Y.

MR. STEPHEN C. BRUNER, formerly assistant pathologist at the Estación Experimental Agronómica, Santiago de las Vegas, Cuba, has been appointed pathologist to succeed Mr.

John R. Johnston, now head of the Office of Sanadad Vegetal, Habana.

Dr. Vern B. Stewart has accepted an appointment in the Bureau of Plant Pathology at Washington, and is now engaged in work on the pathological aspects of market inspection of vegetables.

Miss Zelma Zentmire has been appointed to fill the place of J. J. Hinman, water chemist and bacteriologist at the University of Iowa, who leaves soon for service in the Sanitary Corps of the Army.

H. F. Taylor, assistant for developing fisheries and for saving and use of fishery products in the Bureau of Fisheries, has visited Boston, New York, Pittsburgh and Chicago for the purpose of studying the equipment of industrial laboratories and the assemblage of equipment to be installed in the Bureau's laboratory when built.

The University of Pennsylvania expedition to the hitherto unknown Indian tribes in the mountains between Venezuela and Colombia in charge of Theodore De Booy, curator of the University Museum, has returned, having accomplished its purpose in a much shorter time than was believed possible. This was due largely to the assistance of the Venezuelan government.

According to a press dispatch Vilhjalmar Stefansson, arrived at Dawson, Yukon, on August 29. He is recovering from his serious illness and intends to make a Red Cross lecture tour, beginning in New York in October.

The Royal College of Surgeons, London, has accepted the invitation of the Royal College of Physicians to appoint a joint committee to consider the proposals for the establishment of a Ministry of Health. This committee has co-opted representatives of the Society of Medical Officers of Health, and Dr. Hamer, London, Dr. H. R. Kenwood, Chadwick professor of hygiene in the University of London, and Dr. Robertson, Birmingham, will join the committee. The representatives of the college of physicians are the president, Dr. Norman Moore, Sir Bertrand Dawson, Sir J. F. H. Broadbent, and Dr. Ormerod (registrar). The representatives of the college of surgeons are the president, Sir George Makins, Sir Berkeley Moynihan, Mr. Waring and Mr. Ryall.

The trustees of Cornell University have passed resolutions in memory of Professor Henry Shaler Williams, in which they say:

> As a teacher he was very conscientious; he was especially strong as a teacher in his laboratory, where his close personal attention and his constructive criticism gave his students a training of incalculable value.
>
> As an investigator he attained a very high rank. His studies of Devonian paleontology, of the geological history of organisms, and of the evolution and geographical and geological modification of fossil faunas stand out as important contributions to the literature of these subjects. He was honored by election to the more important American and foreign geological societies.
>
> Although his devotion to his students and his attainments as an investigator gave him eminence, yet to those of us associated with him he will be remembered especially because of his personality. His sweetness and gentleness of character and his thoughtfulness of others won him the love of all who were so happy as to know him.

Dr. Byron D. Halsted, for nearly thirty years professor of botany in Rutgers College and botanist for the New Jersey Agricultural Experiment Station, died at his home in New Brunswick, N. J., on the night of August 27, as the result of paralysis.

Professor F. P. Treadwell, the author of widely used text-books of analytical chemistry, died suddenly of heart-disease at his home in Zürich, Switzerland, on June 24 last. Treadwell was an American by birth (1857, Portsmouth, N. H.), but spent most of his life abroad. His professional activity after serving as Bunsen's lecture assistant from 1878 to 1871 was at the Eidgenössische Polytechnische Schule in Zürich.

The death is reported of M. Maurice Chevreux, the naval engineer. M. Chevreux laid claim to having drawn the plans of the first Zeppelin which succeeded in navigating the air.

The Board of Agriculture of Great Britain has made an order authorizing in England and Wales the killing on and after August 1, until

the next close season, of certain migratory wild birds to increase the food supply.

THE twelfth annual report of the British Science Guild has been published, and copies can be obtained (price 1s. each) on application to the secretary, British Science Guild, 199, Piccadilly, W. London. The report contains addresses by Lord Sydenham, Sir Henry Newbolt and Sir Algernon Firth, delivered at the recent annual meeting of the guild, with particulars of the British Scientific Products Exhibition which is being organized by the guild, and memoranda on the British dye industry, the introduction of the metric system, scholarships for higher education, the teaching of science and other subjects.

As has been noted in SCIENCE active steps are being taken with a view to the establishment at Cambridge of an Institute of Agricultural Botany, the primary function of which will be the breeding and distributing of improved varieties of agricultural crops. We learn from *Nature* that the scheme in question was very fully described by Mr. Lawrence Weaver, of the Board of Agriculture, at a meeting of the Agricultural Seed Association held on July 15. It appears that the new institute will be modelled on the famous Swedish plant-breeding station at Svälof, and that its activities will be to follow two distinct lines, one of which will be purely scientific, while the other will have a commercial outlook. More precisely, the scientific wing will be concerned with the producing of pure cultures of new varieties on the field-plot scale; the economic wing will deal with the growing and distribution on a large scale of these varieties. Presumably, on the Svälof model, the scientific side will oversee the operations of the commercial to the extent of guaranteeing the purity of the stocks distributed by the latter. It has been announced that subscriptions towards the establishment of the new institute amounting in the aggregate to upwards of £30,000, have already been received, including a sum of £10,000 down and £2,000 a year for five years from the firm of Sir Robert McAlpine and Sons. It has also been announced that the Board of Agriculture will provide the necessary buildings and equipment.

A TEMPORARY exhibition was opened in a few of the galleries of the British Museum on August 1. The exhibition galleries were closed by order of the government as a measure of economy in the spring of 1916, and, owing to the necessity of increased precautions against air raids, all the most valuable objects have been removed to places of greater safety. The trustees, however, have deeply regretted the closing of their doors to visitors, and especially to soldiers from the oversea Dominions. An exhibition has accordingly been arranged, consisting chiefly of casts and facsimiles, which it is hoped will both be instructive in itself and representative of some parts of the treasures of the British Museum. The exhibition will include Greek sculpture, classical coins, British coins and medals, historical documents and autographs (naval and military), illuminated manuscripts, early Bibles and other printed books of interest and beauty. If the experiment of reopening is successful, it may be possible to extend it later to other galleries of the Museum. The exhibition is open from 10 A.M. to 1 P.M. and from 2 to 5, each week day. A guide-book to the exhibition is in preparation and photographs and museum publications are obtainable in the entrance hall.

A SPECIAL general meeting of the Royal Society was called on July 31 to consider the advisability of expelling enemy foreign members, and notice of the following motion to be submitted to the meeting was given by Sir George Beilby and Dr. M. O. Forster:

> That, in view of the war having continued during nearly four years without any indication that the scientific men of Germany are unsympathetic towards the abominable malpractises of their government and their fellow-countrymen, and having regard to the representative character of the Royal Society among British scientific bodies, as recognized by the patronage of his Majesty the King, the council forthwith take steps necessary for removing all enemy aliens from the foreign membership of the society.

The London *Times* says: Although Sir George Beilby and Dr. Forster are both members of

the council this resolution is apparently not put forward by the council officially. The notice convening the meeting states that on July 4 the council had under consideration the question of expelling the enemy foreign members. They considered that, if possible, unity of action between the Allied nations should be secured, and in view of the fact that a conference between representatives of Allied academies will take place in October next they resolved to refer the question to that conference. In the meantime they desire to obtain the opinion of the Fellows of the society on the subject for the guidance of their representatives at the conference which has been called for the purpose of discussing the future of scientific work hitherto carried out by international organizations.

From a White Paper published on July 10 *Nature* reports that among the supplementary estimates for the year ending March 31, 1919, is the sum of £1,000,000 which is to be devoted through the Board of Trade to the purpose of assisting the dye-making industry. This is the first instalment of a total sum of £2,000,000 to be provided in the shape of loans and grants to be spread over three years, and divided as follows: £1,250,000 in loans at not less than 1 per cent. above the Bank rate, with a minimum of 5 per cent., repayable in twenty years or earlier if the profits of the manufacturer are more than 9 per cent.; £600,000 in aid of extensions of plant and buildings; and £150,000 in grants in aid of research. It will be remembered that early in 1915 a grant of £1,000,000 was made to one firm at Huddersfield, out of which was created the company known as British Dyes Ltd. This, not unnaturally, created a feeling of dissatisfaction on the part of those dye-making firms which received nothing. The sum mentioned is to be distributed among these firms, besides the substantial amount allocated to the purposes of research. Presumably the £100,000 given for this purpose in 1915 has been spent, but it would be interesting to know how and by whom the money has been used and with what results, in view of the fact that the central research laboratory originally contemplated has never been erected, nor the Technical Committee announced in July, 1915, called into existence.

The provisions of a law enacted by the Congress of Uraguay require the use of the metric system in all trade transactions. Merchants are forbidden to sell by the piece, package, or for a fixed sum of money, even at the request of the customer, articles susceptible of sale by weight or measure without the use of the metric system. The law provides that when merchandise is sold in sealed packages, tin cans, boxes, bundles, bottles, etc., the net contents or weight must be clearly indicated on the wrappers. In pass books used for sales on credit the weight or quantity of the merchandise sold must be stated, and this must also be done in the case of invoices. Staple articles, such as sugar, maté, kerosene, rice, flour noodles, beans and other dry legumes either ground or in the grain, coffee, tea, salt, liquors, coal and wood in general, meats (including canned meats), lard, fresh vegetables, bread, crackers, milk, fish, cheese, sweet and white potatoes, etc., are required when offered for sale to show prices and weights.

The autumn lectures of the New York Botanical Garden will be delivered in the Lecture Hall of the Museum Building of the Garden, Bronx Park, on Saturday afternoons, at four o'clock, as follows:

August 31. "Autumn flowers," by Dr. N. L. Britton.

September 7. "Gladioli," by Professor A. C. Beal.

September 14. "Evergreens," by Mr. G. V. Nash.

September 21. "Dahlias," by Dr. M. A. Howe. (Exhibition of Dahlias, September 21 and 22.)

September 28. "Flora of the vicinity of New York," by Mr. Norman Taylor.

October 5. "Autumn coloration," by Dr. A. B. Stout.

October 12. "Cut flowers and how to use them," by Mr. E. I. Farrington.

October 19. "The value of birds in a garden," by Dr. G. Clyde Fisher.

October 26. "Some plant diseases of New York and Virginia," by Dr. E. W. Olive.

November 2. "Plants as insect traps," by Dr. J. H. Barnhart.

UNIVERSITY AND EDUCATIONAL NEWS

A BEQUEST of $5,000 was made to Cornell University by Dr. William M. Polk, dean of the Medical College, who died on June 23. His purpose in making it was to continue the John Metcalf Polk scholarship in medicine.

A FELLOWSHIP in applied chemistry, of the annual value of £200, has been established at Glasgow University by the trustees of the Ferguson Bequest Fund.

PROFESSOR RAYMOND BINFORD, head of the department of zoology at Earlham College, Indiana, has been elected president of Guilford College, North Carolina.

THE vacancy in the deanship of the medical college of Cornell University has been filled temporarily by the appointment of Walter Lindsay Niles, M.D., 1902, who will act as dean through the summer. Further action will be taken by the trustees in the autumn.

DR. A. J. BIGNEY, on leave from Moores Hill College, has been appointed associate professor of zoology in Syracuse University for the ensuing year. Irving H. Blake, A.M., instructor in Syracuse University has been appointed assistant professor of zoology in the University of Maine.

DR. IVAN E. WALLIN, who was recently advanced to an associate professorship in the school of medicine of Marquette University, has been appointed acting professor and head of the department of anatomy in the University of Colorado school of medicine.

AT Glasgow University Dr. Thomas Walmsley has been appointed lecturer in anatomy, with special reference to embryology. Mr. A. McL. Watson has been appointed lecturer in physiology, with special reference to histology. Dr. John McL. Thompson has been appointed lecturer in botany, with special reference to plant morphology.

DISCUSSION AND CORRESPONDENCE

THE PREVENTION OF ROPE IN BREAD

DURING the course of an investigation of the physical and chemical properties of bread, which is being carried on by officers of the Sanitary Corps under my direction, our attention has been drawn to ropy bread. The development of rope at present causes a serious loss of wheat and leads to much annoyance and uncertainty in the manufacture of bread.

Quite recently Lieutenant E. J. Cohn has made certain observations which, if they could be made widely known, might greatly aid in controlling the present epidemic. Accordingly I venture to report upon them here.

The familiar practise of adding acid to the dough as a means of checking the development of rope turns out to depend upon the fact that what seems to be the common cause of the condition, the growth of *B. mesentericus*, can not take place in bread at a greater hydrogen ion concentration than $10^{-5}N$. At the present time the addition of wheat substitutes in bread-making complicates the situation in two ways; first, because such substances commonly produce a less acid bread, and, secondly, because it is more difficult to find out what quantity of acid is desirable on account of the constantly changing conditions.

It is possible, however, to measure the hydrogen ion concentration of bread by the addition of the ordinary solution of methyl red (0.02 per cent. in 60 per cent. alcohol) to the freshly cut surface of the loaf. Three or four drops of the indicator should be placed upon a single spot and five minutes should be allowed to pass. Then, if the color is a full red without an orange nuance, the hydrogen ion concentration is approximately $10^{-5}N$, or more. If an orange tint develops, greater amounts of acid should be added to successive batches of dough until the test with bread just gives the desired color. Our experience seems to show that the growth of rope is inhibited as the hydrogen ion concentration approaches $10^{-5}N$, and that bitter flavor in bread appears only at greater acidities.

Professor Wolbach, of the Harvard Medical

School, has very kindly carried out the bacteriological experiments upon which these results largely depend.

LAWRENCE J. HENDERSON
WOLCOTT GIBBS MEMORIAL LABORATORY,
HARVARD UNIVERSITY

A MICROSCOPIC TRAP

WHILE examining a very rich culture of Protozoa, recently, I saw a living animal caught in the smallest trap that I have ever heard of, about 1/13 mm. in length. The animal was a small Infusorian, apparently *Colpoda cucullus* Mül., as well as could be determined in its cramped position in the trap. The trap was an empty shell of a small species of *Arcella*.

The Infusorian had apparently entered the opening of the empty test and then, after the manner of a fish in a trap, kept swimming around and around the periphery of its prison, thus never coming to the centrally placed opening. I watched it pretty constantly for an hour and a half and it apparently never ceased, for more than a second at a time, its

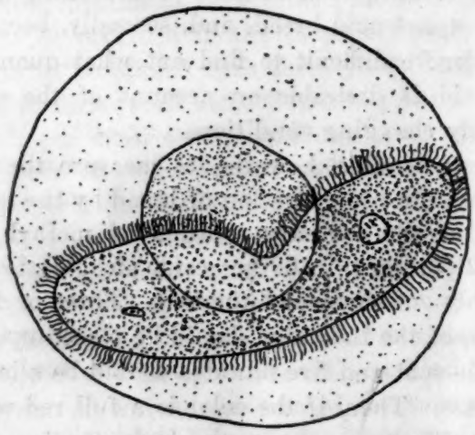


FIG. 1. A small Infusorian trapped in the empty shell of a fresh-water Rhizopod, *Arcella*. Camera lucida; × 630.

forward or backward motion, except that, occasionally, it halted its progressive movement and whirled around rapidly, at a rate of 100 per minute, upon its median transverse axis.

After being under observation for an hour and a half it suddenly became quiet, and, but for the contraction of its vacuole about every 25 seconds, it seemed to be dead. Then it suddenly resumed its swimming and whirling motions, which were continued, with occasional resting periods, till observations ceased at the end of the day, 2½ hours from the first observation.

The slide had been sealed with oil to prevent evaporation of the water, so that the next morning the culture was in good condition, but the prisoner had escaped, during the night, from its trap.

The figure is a camera drawing, showing the animal in the trap, bent to the right, and indented on that side.

ALBERT M. REESE
WEST VIRGINIA UNIVERSITY

A NIGHT RAINBOW

A MOST wonderful display of aurora borealis was visible on Mount Desert Island last night and had the moon not been at first quarter the brilliancy of the display would undoubtedly have been still greater. It had its base on a long, dark, unbroken band abutting on the northern horizon and shot upwards toward the zenith in innumerable streamers of vast reach, lengthening and shortening and shifting like the beams of a gigantic searchlight. Suddenly at about 10:40 P.M. a band like a gray-colored rainbow darted across the heavens near the zenith, passing from northwest to southeast and ending at a point near but not at the horizon. Though it may be common I have never seen the aurora span the heavens in that fashion. It looked like a vast single-span bridge. Beginning west of Arcturus it passed midway between Lyra and Aquila and ended far down in the southeast. At its midpoint overhead it was about as wide as the line joining the three conspicuous stars of Aquila. It seemed to be lower than the firmament, creating the impression of pulling the sky downward and giving a limit to space. Unlike the streamers first seen it did not suggest a searchlight but rather a band of delicate gray veiling, shining, yet not luminous—a night rainbow. It was densest near the zenith but even there the stars were visible through it.

For about thirty minutes little change could

be noticed in it, then it broke up lengthwise and crosswise, moving at the same time still nearer the zenith. A few moments later short parallel streamers began to shoot out from it at right angles and in a northerly direction giving the appearance of the prongs of a crown. Thereafter the long gray bow gradually vanished and in its place appeared irregular small grayish cloud-like masses moving swiftly to and fro across the zenith while short streamers continued to dart upward from the northern horizon.

DAVID RIESMAN
NORTHEAST HARBOR, MAINE,
August 16, 1918

SCIENTIFIC BOOKS

South America. By NELLIE B. ALLEN. New York, Ginn and Company, no date (1918?). Illustrated. 12mo. Pp. xv + 413.

This book seems to be one of a series of "geographical and industrial studies." The author is connected with the state normal school at Fitchburg, Mass., and the book is intended for use of "the children in our schools."

It is a book of good intentions written down to young people; and as young people are in the habit of accepting as the truth all the statements they find in print we feel at liberty to ask whether the children are being properly served. It contains a great deal of the stock information to be found in books of travel, circulars, reports and papers about South America, and mixed in with it are many things that might better have been omitted.

One of the most striking things about it is the air of artificiality and false enthusiasm that the author seems to think it necessary to maintain. It is difficult to keep up such high pressure activities, and, at the same time, to verify statements and to discriminate between trustworthy and untrustworthy authorities. The result is a demoralizing tendency towards exaggeration and sensation. For example, a pile of wheat twenty-five or thirty feet high is called a "mountain of wheat" (pp. 172–3); wheat fields are "a sea of wheat" (p. 171); trains "shoot in and out of tunnels" (p. 127); "cold storage plants are bursting with tons of beef" (p. 162), and maté "becomes as solid as a rock" (p. 197).

Allowances may be made for such evident exaggerations, but unfortunately there are interspersed among them a long list of misleading half-truths, of which the following are examples: Bahia "is guarded by strong forts" (p. 86); "both men and women in Brazil smoke" (p. 86); maté "enables people to do their work and endure hardships without fatigue" (p. 195); "bread (is) made from manioc flour" (p. 201); "Brazil is larger than the United States" (p. 78), and the carriage drive over the crest of the Andes is a "dangerous trip" (p. 225).

Certain other statements are even less than half-truths: speaking of the Amazon region, she says the "forest is always . . . brilliant with flowers" (p. 106); as a matter of fact it is rarely brilliant with flowers. The sandstone reefs of Pernambuco and the coast are called "the great coral reef," and the "coral seawall" (pp. 82–83). It is said that petroleum has been discovered in Brazil (p. 89) (it has not); that "rich beds of . . . platinum are known to exist" in Brazil (p. 89) (they are not); and, among other things, "*pearls . . . are mined in various parts of the country*" (p. 89)!

A writer who makes such haphazard statements can hardly be expected to discriminate in regard to information of any kind. Thus we are told that Paraná means "in the Indian language, 'mother of the sea'" (p. 145); Dr. Theodoro Sampaio, an authority on the Tupi, says it means "like the sea" or "as big as the sea." At page 103 it is said that the wet season in the Amazon valley is from November to February; Carvalho's "Météorologie du Brésil," pp. 205 and 216, says it is January to May at Pará, December to June at Obidos, and January to May on the Negro.

The palm nuts used to smoke rubber in the Amazon region are spoken of as "the fuel he (the rubber cutter) likes best" (p. 119). It is not a matter of what he likes, but a demand of trade. From the beginning of the rubber industry to the present the rubber gatherers of the Amazon region have considered it nec-

essary to use for rubber smoking the nuts of the Urucury palm, botanically known at *Attalea excelsa*.[1]

Of Rio de Janeiro it is said that a person who visited that city twenty-five years ago would hardly recognize the city to-day, and that "the traveler who was so unfortunate as to be obliged to stop there held to his nose a handkerchief saturated with disinfectant as he made his way through narrow, dirty, undrained streets" (p. 93). Such statements may make an effective background for references to the present healthfulness of that city, nevertheless, they are gross exaggerations. The statement (p. 93) that the people of Rio "learned from the United States how to make the city a pleasant healthful place to live in" is misleading to say the least. The fact that malaria was transmitted by mosquitoes was discovered by a surgeon in the British army. And as for Rio's beautiful Beiramar, we regret to say that there is no such a water front drive in the whole United States from which it could have been copied.

Both maps and text keep up the ancient myth about the forests of the Amazon valley being called *selvas* (pp. 105, 125). As a matter of fact they are called *mattas* by the people, and the forest map of Brazil by Dr. Gonzaga de Campos calls them *mattas*. But why must a foreign word be used at all? They are simply tropical forests.

But errors of statement that may be matters of oversight are of less importance than the attitude of teachers who think it necessary to use extravagant language in order to awaken the interest and to hold the attention of pupils. At page 123 we are informed that Indians have gathered the rubber, the sailors have manned the ships, and the workmen in the factories "have spent their time *in order that you may be protected from the wet.*" There is not a workman in that list who doesn't know better. And when attention flags, something more startling than usual must be injected into it. "Did you hear that loud report? Look at the column of smoke rising in the field over to the right" (p. 267). It turns out to be nothing more serious than the workmen blasting out the rocks in the nitrate fields. And though the nitrate regions of Chile are in low hills along the western margin of a flat ancient lake bed she says the "surface of the country is all upheaved" (p. 266), and gives a picture of waste rock from the quarries as evidence of the upheaval. Fictitious resemblances between the United States and Brazil are discovered (p. 78); while "Lying in its wide mouth, as the prey might lie in the open jaws of a great serpent, is the island of Marajo" (p. 104).

Some of this writing down to students is harmless enough, but one wonders why it is necessary to use a platitude instead of plain English; for example, coffee is called "our morning cup," and she "explores" the streets of Buenos Aires (p. 164). All of which is in keeping with certain other hackneyed expressions, such as: Bahia bay is "large enough to hold all the navies of the world" (p. 86); "every part of the animal, except the bleat and the bellow, is made use of" by the meat packers (p. 181). The pity of it all is that when the author forgets these antics and sticks to facts and to plain English she is an interesting writer, a fact which leads one to conclude that it is the system that is at fault rather than the author of the book.

There are legitimate ways to hold the attention of students, and there is a reasonable mean between buffoonery and the dry-as-dust way of presenting instruction. The idea that studies must be made entertaining has so penetrated our schools, our teachers, and our text-books, that the seriousness of education is well nigh lost sight of in the sensationalism, extravagance, and unwholesome lack of sincerity that naturally springs from such false conceptions.

John C. Branner

Stanford University,
California

[1] Wallace's "Palm Trees of the Amazon," p. 118.

PATENT REFORM PROSPECTS

The following letter is published for the information and suggestions it contains:

PATENT OFFICE, WASHINGTON, D. C.,
July 29, 1917.

MR. F. F. WITHROW, AND OTHERS,
Patent Office, Dept. of Agriculture,
Ottawa, Canada.

Gentlemen: Below is submitted a general response to your valued letter of inquiry dated July 4, 1918. You may find it largely an extenuation of present comparative inaction.

The first definite steps toward the founding of our society were, in point of fact, taken by a group of assistant examiners more than a year since. Hon. Thos. Ewing, at that time commissioner of patents, lent some countenance to the movement, after ascertaining the favorable majority sentiment of the corps. The society and its work are still too undeveloped to justify much retrospect, but it is a matter of special gratification here that the membership has now been extended to include not only all chiefs of examining divisions, and the vast majority of assistant examiners, but also all chiefs of other divisions and all higher officials—thus including the present commissioner, Hon. J. T. Newton, First Assistant Commissioner Whitehead, and Assistant Commissioner Clay—whose paper reproduced in the *Scientific American Supplement* for January 9, 1918, is enclosed herewith.

Provision is made for associate membership on the part of those not members of the examining corps, the present fee being one dollar per annum; also for honorary membership, without fee. No honorary members have yet been elected.

The general objects of the society are perhaps best epitomized in the phrase "Devoted to the Improvement of the Patent System," which its stationery now bears. The society is of course interested in the promoting of mutual acquaintance within the office and with those who have business before it; in the elevating of standards of practise, information and efficiency; in the improvement of working conditions, methods and equipment; in better opportunities and incentives; in better organization and informative resources; and (by no means least) in meeting more than half way efforts toward patent reform on the part of any and all who may appreciate the predicament of the office and the possibilities and public importance of better patents and greater security therein.

In conformity with a resolution adopted by the Patent Office Society and fully concurred in by Commissioner Ewing while in office, the National Research Council, with expanding offices now at 1025 16th St. in this city, appointed, in 1917, a committee for the preliminary study of Patent Office problems. Under the chairmanship of Dr. Wm. F. Durand (now in France), several meetings of this committee were held, at two of which there were presented discussions arranged for by a special committee of the Patent Office Society—although responsibility for views expressed was, of course, entirely personal. The first paper presented as referred to was that of Mr. M. H. Coulston, at that time a law examiner (now chief clerk, and also president of our society), and it related to patent appeals. That paper, with slight changes by its author, our committee in charge of the forthcoming *Journal of the Patent Office Society* has decided to print in an early issue—moved thereto perhaps equally by the spirit in which it was prepared, by a subordinate in the "system," and by the intrinsic importance of its topic. Other discussions presented at the meetings referred to were as follows:

Procedure and conclusions of the President's Commission on Economy and Efficiency in their investigation of the Patent Office in 1914;
Needed legislation relating to assignments, or to the work of the assignment divisions;
The needs of the Patent Office library;
Suggested changes in the interference practise;
Proper soliciting and adequate searches;
The improvement of patent claims;
The need of a secondary classification of patents, based on industrial arts;
The essentials of a proper Patent Office building;
Incentives and opportunities within the Patent Office;
A proposed reorganization of the examining corps.

The mentioned committee of the N. R. C. (whose complete original membership, comprising some of the most noted of American scientists, engineers, inventors and authorities in patent law, was published in SCIENCE for December 26, 1917), is understood to have convened more recently at the New York offices of Mr. E. J. Prindle, the present chairman being Dr. L. H. Baekeland, of Yonkers, N. Y. Early enlargement of the committee was anticipated, and an additional committee of prominent engineers has in fact been appointed, under the chairmanship of Chas. A. Terry, E.E., by the United Engineering Societies, the last-named committee having authority to cooperate with the N. R. C., and others, in patent reform efforts.

As a consequence of the receipt of such information as the foregoing, and notwithstanding the fact that military and naval problems of the utmost urgency do seem to have foreclosed a first mortgage upon the *present* attention of all those men upon whom successful patent reform must depend, the "small beginnings" mentioned are still believed here to afford some promise of real prog-

ress; *c'est le premier pas qui coute!* And in this connection attention may be called to a heartening Executive Order of President Wilson's, dated May 11, 1918, which includes the following:

> The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council, the duties of which shall be as follows:
>
> In general, to stimulate research in mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts. . . .
>
> To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.
>
> To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science. . . .

The international character thus given to the National Research Council as a public, permanent institution will not escape notice. Are we not justified in feeling that we have hitched our wagon to the proper star? At any rate, obliged to live on corn meal and confidence, some of us especially value the latter!

The movement toward a Washington location for that great International Institute for the history of science proposed by Dr. George Sarton and others (and coveted as an associate by the Patent Office) also appears here to await a more favorable moment for public attention—although the resolutions upon this subject adopted by the Patent Office Society have already been strongly seconded by the Washington Academy of Sciences, and the American Society of Civil Engineers, as well as by several of the powerful scientific bodies local to this city. At a suitable moment, this project may be again pressed, although leadership therein is understood to devolve upon Dr. Sarton. . . .

How intrinsically absurd must appear the complete duplication, within each nation, of all those facilities and technical qualifications prerequisite to the proper determination of such purely *research* questions as operativeness, and novelty of conception! Surely the possible economy in search-costs alone must appeal more and more strongly not only to the inventors, who pay these particular bills, but to that increasing multitude now fortunately interested in the proposals looking toward a league of nations—or, at least, of democratic states! How much better the work of both could be done if the Canadian Patent Office and that of the United States could be coordinated at once, with united resources of men and means!

Salary resolutions, calling attention to the fact (ascertained by a questionnaire sanctioned by Commissioner Newton) that the great numbers of men annually leaving the office commonly double their incomes within three years; to the lack of satisfactory recruits, or of means for retaining properly qualified men; to the rapid consequent rate of resignation even for non-military employment; and to the corresponding jeopardy of inventor's rights entrusted to unqualified and inexperienced men, were duly approved by the executive committee of the Patent Office Society, but have been withheld from publicity—apparently because of misgivings lest shouting while cannon roar may be misunderstood—if it happens to be noticed at all!

Meager as they are, the assets of the society have proved sufficient to enable it—meeting as it does in the Patent Office Building—to purchase a projection apparatus adapted for motion pictures, of which notable use has already been made in showing the development and practise of particular arts; and also to tempt it, under the active leadership of President Coulston, into an essay at the publication of the mentioned *Journal*. For the first year, the price of this is fixed at $2.50, and its columns are intended to contain not only expositions of the present somewhat complicated practise, but also material deemed to deserve further consideration whenever the day for real patent reform shall dawn. These activities, for which some manuscripts are already at hand, may, of course, pave the way to a still wider field of usefulness: for in scientific and technical fields, as well as in legal, the possibility of suitable publication of historical studies must, of course, be accounted a legitimate incentive to study.

Possibly indeed any society centering in a government office must consider itself limited forever to an opportunist policy, making real advances, other than those of self improvement, only when the breath of a very genuine and generous official approval—undisturbed by the anxieties of a period of war—shall accord, during some constructive period, with a current of awakened public interest. Yet it is not without confidence that our society

now hoists its modest banner, believing that the administration of Secretary Lane under President Wilson affords a peculiarly favorable moment for the initiation of cooperative efforts of which the justification may be rational, rather than merely traditional. Obviously, those patent reform efforts which the National Research Council is understood to have deferred (in so far as they have been deferred) only by unavoidable necessity can reach the largest effects only as a result of a very comprehensive movement—in regard to which all interested and competent parties should be heard. And (if every other special qualification be disputed) who so well as examiners and assistant examiners can tell how distressing a thing it is for men charged with exhaustive research, and with judicial responsibilities therein, to be obliged to act hastily and superficially upon matters involving the largest public and private interests?

Lightly tossing a very broad challenge, one might ask—"Do not the prospects of democratic government, in competition with more centralized forms, ultimately depend on the capacity to initiate, to organize, to present and to utilize criticism. Within a republic, does not the duty of utterance devolve upon all who possess special information? But we now press only the more specific question: Is it not reasonably possible that manufacturers, investors, practitioners, jurists, publicists, scientists and engineers, as well as inventors of every field and grade, conferring under the coordinating influence of so disinterested and competent a body as the National Research Council, will, from this time forward, work more and more effectively to insure the *prompt* grant of *proper* patents—only; and to make the genuine inventor, the investor and the public alike really *secure* by a very clear and a very just definition of rights? Upon the determination of this one fundamental question we do urge an early test—before still more complete failure of the patent system shall bring it into utter contempt—even though in the execution of such a test we, the "proponents," may be able to undertake only a very subordinate part.

At least, we of the Patent Office Society hope we simplify the situation by inviting—for possible publication, and by no means in a spirit of challenge—criticism of any phase or feature of the present patent system. May we not soon hear again from yourselves?

Sincerely and fraternally,

BERT RUSSELL,
Secretary, Patent Office Society

SPECIAL ARTICLES

POLARIZATION IN CASE OF MOVING ELECTRODES

IN connection with other work, I incidentally came upon the following phenomenon which I have not found clearly stated anywhere; though from the enormous amount of work done on polarization, I can hardly suppose it to be new. In part it might be surmised from Hittorf's researches on the migrations of the ions.

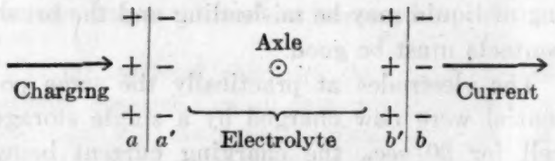
In order to keep the resistance of the circuit constant, bright zinc electrodes, facing each other diametrically, and set tangentially to the arc of motion, were rotated around a vertical axis midway between, in an electrolyte of dilute brine. A small electromotor and pulleys, collector rings and brushes made up the remainder of the apparatus. Special care was taken that all parts of the circuit, except the free zinc surfaces to be tested, were thoroughly insulated; for the effects produced by splashing of liquid may be misleading and the brush contacts must be good.

The electrodes at practically the same potential were now charged by a single storage cell for 30 sec., the charging current being .16 am. for electrodes of about 26 sq. cm. each. On breaking, the polarization was naturally enormous (needle off scale); but it vanished rapidly in the well-known way, being counter to the charging current. When this polarization had fallen to about -0.010 volt, the electrodes were rotated. At once the polarization changed sign and was again enormous (needle off scale) and in its turn fell off in the usual way. When it had fallen to $+0.004$ volt the electrodes were stopped, leaving $+0.003$ volt, about.[1] Subsequent motion increased the electromotive force slightly in the direction of the charging current. In other words this second or residual polarization observed during the motion of the electrodes is astonishingly strong and *in the direction of the charging current.* To test this further, the latter was reversed many times, always reversing the phenomena as a whole, while in character they remained the

[1] Different experiments give different data, without changing the character of the values.

same. The electrodes must be bright, as otherwise the phenomenon becomes very complicated. Furthermore the original polarization must often surpass a certain value if the residual polarization is to be contrary in sign; and there are other differences in detail for which there is no room here. Thus the rotational effect may proceed gradually to a maximum; an electromotive force zero may imply a very large residual polarization appearing on motion. The charging of moving electrodes is an interesting case; etc.

To elucidate this phenomenon, it suffices here to assume the occurrence of paired double layers $a\ a'$ and $b'\ b$, one double layer at each electrode. One element, a', b', of each double layer is localized in the liquid and the other element a, b in the solid electrode, both of the double layers having the same direction; *i. e.*, being two condensers in series. Hence there are two interpenetrating electrostatic fields, one



$b'\ a'$ localized in the liquid and the other $a\ b$ in the electrodes. These fields are in a contrary direction and the liquid field must be very much stronger to correspond with the initial counter polarization. On rotating the electrodes, the field localized in the liquid $b'\ a'$ is set free and its ions dissipated. The field localized in the solid, $a\ b$, however, remains and this constitutes the residual polarization in the direction of the charging current. Both fields decay in the lapse of time in the usual way.

When rotation ceases a liquid field is reestablished, but usually, though not always, to a smaller degree. Eventually a probably discharges a' and b, b', one of the fields passing through zero first, so that the effect of rotation finally vanishes. I have met both with marked polarization which on rotation vanished, as well as with an apparent absence of polarization which on rotation became very marked.

To obtain moving electrodes as free from polarization disturbances at the contact with a liquid, it is therefore prudent to capture both fields; *i. e.*, to leave the electrodes entirely without interferences. This may be done by surrounding each with a porous cup, closed and completely filled with an electrolyte, the terminals passing out through an insulating tube. The electrodes should moreover be fixed rigidly to the cup. Again since zinc electrodes soon tarnish in brine but remain bright in concentrated zinc sulphate solution, the latter is a preferable electrolyte and the cups may be submerged in brine or any other solution.

I therefore constructed two cup electrodes of the kind in question and placed them in the rotational apparatus as before. The original potential difference of the zincs was about .4 millivolt. After keeping the circuit closed over night this fell off to below .05 millivolt, and could be eliminated by exchanging the cup electrodes. Rotation of the appartus, *i. e.*, an external current in the brine surrounding the cups, produced no appreciable effect. The electrodes were then charged with a current of .2 am. for 30 sec. The polarization remaining was now much less than above, throughout, beginning with about 5 millivolts which fell to .5 m.v. in 5 minutes and to .05 in a few hours. Rotation was ineffective through all stages of the decay. No doubt the simple electrode in which both the original and the residual polarizations have vanished would often suffice, but with greater uncertainty, because such electrodes can not be exchanged without danger as to modifying their value.

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